T 6: Suche nach dunkler Materie I

Zeit: Montag 16:00–18:20 Raum: Philo-HS6

Gruppenbericht T 6.1 Mo 16:00 Philo-HS6
Direct Dark Matter Search with the CRESST-III Experiment — •Andrea Münster for the CRESST-Collaboration — Physik-Department E15 und Excellence Cluster Universe, Technische Universität München, Garching, Germany

The CRESST (Cryogenic Rare Event Search with Superconducting Thermometers) experiment, located at the Gran Sasso underground laboratory (LNGS) in Italy, aims at the direct detection of dark matter particles via their elastic scattering off nuclei. The target material consists of scintillating $CaWO_4$ single crystals operated as cryogenic detectors at millikelvin temperatures. For several years, these crystals have successfully been produced within the collaboration at the Technical University of Munich (TUM) and a significant improvement in radiopurity could be achieved. In CRESST-II Phase 2, an extended physics run between 2013 and 2015, the experiment demonstrated its leading sensitivity in the field of direct searches for dark matter masses below 1.7 GeV/c^2 . A further detector optimization for the search of low-mass dark matter particles was performed for CRESST-III, whose Phase 1 started taking data in summer 2016. In this talk the performance of the CRESST-III detectors as well as first results will be presented. Requirements and perspectives for the upcoming CRESST-III Phase 2, in particular with respect to radiopurity, will be discussed.

T 6.2 Mo 16:20 Philo-HS6
Modelling of electromagnetic backgrounds in the CRESST experiment — •Holger Kluck[1,2] and Cenk Türkoğlu[1,2] for the CRESST-Collaboration — [1]Institut für Hochenergiephysik der Österreichischen Akademie der Wissenschaften, 1050 Wien, Österreich — [2]Atominstitut, Technische Universität Wien, 1020 Wien, Österreich

CRESST searches directly for dark matter (DM) with $CaWO_4$ crystals operated as cryogenic calorimeters. It established leading limits for the spin-independent DM-nucleon scattering cross-section down to DM-particle masses of 350 MeV/c^2. At this mass regime, the rejection power against electromagnetic background starts to degrade. The background in the region of interest is mainly caused by β and γ decays of radioactive contaminations in the $CaWO_4$ crystals and their Cu surrounding. To gain a reliable understanding of these background components a detailed Geant4 model of the contaminations is under development.

In this contribution we report the current status of the benchmark simulation used to validate the model. We discuss the absolute normalization of the simulation via sideband measurements of α decays. Finally, we show preliminary results of a validation against experimental reference data.

T 6.3 Mo 16:35 Philo-HS6
Background suppression through pulseshape analysis in the DEAP-3600 dark matter detector — •Moritz Burghardt[1] and DEAP Collaboration[2] — [1]TU München — [2]SNOLAB, Canada

DEAP-3600 is a dark matter direct detection experiments at SNOLAB, Canada using a single phase liquid argon target. Upon energy deposition of ionising particles, liquid argon emits light through the decay of short-lived singlet state and long-lived triplet state excimers. This light makes up the only dark matter signal channel and is detected by an array of 255 photomultiplier tubes. In order to reach the projected sensitivity to WIMP-nucleon cross sections of 10^{-46} cm^2 for 100 GeV WIMPs, the electronic recoil background, which is dominated by the beta-decaying ^{39}Ar, has to be suppressed by a factor of at least 10^{-8}. This is achieved through pulseshape discrimination (PSD): electronic recoils produce a different singlet to triplet excimer ratio than the nuclear recoil signal from a WIMP interaction, leading to different time structures of the pulse shape. In this talk, prompt-window-based and likelihood-based PSD-parameters are presented and evaluated based on their discrimination power in DEAP-3600.

T 6.4 Mo 16:50 Philo-HS6
Radon background in the dark matter experiment XENON1T — •Natascha Rupp — Max Planck Institut für Kernphysik, Heidelberg

The dark matter experiment XENON1T aims for a direct detection of WIMPs (weakly interacting massive particles) by using liquid xenon as target material. The noble and radioactive gas radon constitutes the dominant background source in XENON1T. It constantly emanates into the liquid xenon and potentially reaches the sensitive volume, where the decay of its daughter isotopes can mimic dark matter interactions. A careful selection of low-radon-emanating detector materials mitigates this source of background. Therefore, radon emanation measurements of the individual detector parts are performed before construction. A few results of those measurements are presented. Furthermore, the level of radon and certain daughter isotopes is determined in the data analysis, which allows to set limits on the induced background rate. It was seen that the total radon level in the detector determined by emanation measurements and in data analysis agree well with one another.

T 6.5 Mo 17:05 Philo-HS6
Simulation studies for the MADMAX Axion direct detection experiment — •Jan Schütte-Engel for the MADMAX-Collaboration — University Hamburg, Deutschland

Axions are hypothetical particles introduced to solve the strong CP problem of the Standard Model. In addition axions can resolve the dark matter mystery. Axions with masses in the range of a few μeV up to a few hundreds of μeV are furthermore motivated by the scenario in which the Peccei-Quinn symmetry is broken after inflation, and in which the vacuum realignment mechanism and decays of topological defects contribute to the dark matter density. These motivate the search for axions in direct detection experiments on Earth, and the development of new techniques to become sensitive to this specific axion mass region.

One option is the MADMAX experiment, a haloscope utilizing dielectric media to enhance the signal of photons converted axions. This talk will focus on the simulation of the MADMAX direct detection axion experiment, and especially on the investigation of the dielectric discs, including real experimental conditions and discussing some of the signal loss mechanisms which may impair the axion detection.

T 6.6 Mo 17:20 Philo-HS6
Potential sensitivity of dark-matter searches for hidden photons with the FUNK experiment — •Arnaud Andrianavalomahefa[1], Kai Daumiller[1], Babette Döbrich[2], Ralph Engel[1], Joerg Jaeckel[3], Marek Kowalski[4,5], Axel Lindner[4], Hermann-Josef Mathes[1], Javier Redondo[6], Markus Roth[1], Thomas Schwetz-Mangold[1], Christoph M. Schäfer[1], Ralf Ulrich[1], and Darko Veberic[1] — [1]Institute for Nuclear Physics, Karlsruhe Institute of Technology (KIT), Karlsruhe, Germany — [2]Physics Department, CERN, Geneva, Switzerland — [3]Institute for Theoretical Physics, Heidelberg University, Germany — [4]Deutsches Elektronen Synchrotron (DESY), Zeuthen, Germany — [5]Department of Physics, Humboldt University, Berlin, Germany — [6]Department of Theoretical Physics, University of Zaragoza, Spain

The FUNK experiment is dedicated to look for an eventual signal from a new subclass of light particles, dubbed hidden photons (HP), which could explain the whole cold dark matter. The experimental apparatus uses a large parabolic metallic mirror ($\sim$ 15 m^2) where a faint electromagnetic signal resulting from a HP-to-photon conversion may emerge from the mirror's dielectric surface and gets focused at its center of curvature where a suitable detector is placed. Current measurements are performed in the optical range frequency and look for HP with mass $\sim$ 1 eV. The same setup is also suitable for a broadband scan in regime where diffraction effects can be neglected. We discuss the prospective sensitivity of FUNK in the terahertz domain.

T 6.7 Mo 17:35 Philo-HS6
Mitigating detector effects in Dark Matter searches with the ATLAS Experiment — •Thomas Spieker — Kirchhoff Institut für Physik Heidelberg

The particle nature of Dark Matter (DM) is one of the main open questions in particle physics. So far, none of its detection attempts were successful. Testing and constraining the many models and theories predicting DM is a challenge as only few of them can be considered in an analysis. The search results are usually presented at detector level, which makes reinterpretation in terms of additional models difficult.

A Dark Matter search in final states with missing transverse momentum and jets was performed with the ATLAS Experiment using a novel approach. The results were unfolded to particle level using bin-to-bin unfolding. This simplifies the comparison of new theories with the presented results, as any detector effects are fully corrected for and can be compared at particle level. In a new, more refined iteration of the analysis the unfolding procedure will be performed using an iterative, dynamically stabilized Bayesian method. This approach depends less on the Monte Carlo modeling of the relevant processes and therefore yields a more reliable result at particle level. By using unfolding techniques in searches a much wider range of theories can be probed, just as changes in existing models can be compared more easily.

T 6.8 Mo 17:50 Philo-HS6

Suche nach Dunkler Materie in Assoziation mit einem hadronisch zerfallenden W- oder Z-Boson mit den Run-2-Daten des ATLAS-Detektors — •Philipp Gadow, Sandra Kortner, Oliver Kortner, Hubert Kroha, Patrick Rieck und Makoto Teshima — Max-Planck-Institut für Physik (Werner-Heisenberg-Institut), München

Die Existenz Dunkler Materie wird durch zahlreiche astrophysikalische Hinweise untermauert, jedoch steht ein Nachweis der genauen Teilchennatur noch immer aus. Hypothetische Teilchen der Dunklen Materie können in *pp*-Kollisionen am LHC in Paaren gemeinsam mit Teilchen des Standardmodells erzeugt und so über Signaturen mit fehlendem Transversalimpuls nachgewiesen werden.

Dieser Vortrag stellt die Suche nach Dunkler Materie in assoziierter Produktion mit einem hadronisch zerfallenden W- oder Z-Boson vor, basierend auf den Run-2-Daten des ATLAS-Detektors. Die Signalsignatur ergibt sich aus den als Jets rekonstruierten Zerfallsprodukten der Vektorbosonen und dem fehlenden Transversalimpuls der nicht mit dem Detektor wechselwirkenden Teilchen der Dunklen Materie.

Die Ergebnisse der Suche werden vorgestellt, welche im Rahmen von vereinfachten Modellen interpretiert werden.

T 6.9 Mo 18:05 Philo-HS6

Search for Dark Matter in the Mono-Higgs Channel — •Andrea Matic and Jeanette Lorenz — Ludwig-Maximilians-Universität München

Astrophysical measurements show that a significant fraction of the mass-energy density in the universe consists of dark matter (DM). However, the particle nature of DM is still unknown. Dark matter candidates need to be massive particles, which might be weakly interacting. If produced in proton-proton collisions at the LHC, DM particles would not interact with the detector material and the resulting signature would be characterized by high missing transverse energy.

A search for DM is presented, which is based on data taken with the ATLAS detector at a center-of-mass energy of 13 TeV. The channel studied is sensitive to the pair production of DM particles in association with a Higgs boson, which decays further into two b-quarks. Depending on the momentum of the Higgs boson, this decay can have two different signatures: Either two resolved b-jets or one large-radius jet with two b-tagged tracks.

This talk presents the analysis strategy in the mono-Higgs channel and the statistical interpretation of the results.